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ABSTRACT

The viability of visual imagery as a prose-learning process was evaluated in two experiments with elementary school children in this study. In experiment one, two concrete ten-sentence passages were constructed. The attributes of two subclasses were contrasted in each passage (two kinds of monkeys in one passage, and two kinds of cars in the other). The attributes associated with one of the subclasses were presented in the first five sentences, and those of the other subclass were presented in the second five sentences. Forty-eight fourth graders were randomly assigned in equal numbers to one of four experimental conditions. Each subject was then presented one of the two passages either in a reading condition or a listening condition. Experiment two used slightly modified experiment one passages mounted on slide transparencies. Each slide could be presented at a fast rate of three and one-half seconds or a slow rate of seven seconds. Fifth-grade subjects were shown the sentences at either the fast or slow rate, and in the listening condition sentences were read at either a fast or slow rate. The results indicated that when a passage was presented at a normal rate, the effect of imagery instructions on substance recall was relatively greater under listening than under reading conditions. (Author)

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STRATEGIES IN READING COMPREHENSION:
III. VISUAL IMAGERY AS A PSYCHOLOGICAL PROCESS

by

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Report from the Research Component <u>Conditions of School Learning and Instructional Strategies</u>

Wisconsin Research and Development
Center for Cognitive Learning
The University of Wisconsin
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Statement of Focus

Individually Guided Education (IGE) is a new comprehensive system of elementary education. The following components of the IGE system are in varying stages of development and implementation: a new organization for instruction and related administrative arrangements; a model of instructional programing for the individual student; and curriculum components in prereading, reading, mathematics, motivation, and environmental education. The development of other curriculum components, of a system for managing instruction by computer, and of instructional strategies is needed to complete the system. Continuing programmatic research is required to provide a sound knowledge base for the components under development and for improved second generation components. Finally, systematic implementation is essential so that the products will function properly in the IGE schools.

The Center plans and carries out the research, development, and implementation components of its IGE program in this sequence: (1) identify the needs and delimit the component problem area; (2) assess the possible constraints—financial resources and availability of staff; (3) formulate general plans and specific procedures for solving the problems; (4) secure and allocate human and material resources to carry out the plans; (5) provide for effective communication among personnel and efficient management of activities and resources; and (6) evaluate the effectiveness of each activity and its contribution to the total program and correct any difficulties through feedback mechanisms and appropriate management techniques.

A self-renewing system of elementary education is projected in each participating elementary school, i.e., one which is less dependent on external sources for direction and is more responsive to the needs of the children attending each particular school. In the IGE schools, Center-developed and other curriculum products compatible with the Center's instructional programing model will lead to higher student achievement and self-direction in learning and in conduct and also to higher morale and job satisfaction among educational personnel. Each developmental product makes its unique contribution to IGE as it is implemented in the schools. The various research components add to the knowledge of Center practitioners, developers, and theorists.

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Abstract

The viability of visual imagery as a prose-learning process was evaluated in two experiments with elementary-school children. In the first experiment, it was found that when a passage was presented at a normal rate the effect of imagery instructions on substance recall was relatively greater under listening than under reading conditions. This finding was replicated in the second experiment where it was also found that reported imagery generation was more frequent in listening than in reading conditions when a faster presentation rate was employed. Possible interpretations of the results with respect to a "compatibility" hypothesis are offered.

I
Introduction

Much attention has been devoted to the role of visual imagery in children's learning, and its development with age (cf. Levin, 1972b; Reese, 1970). Recently investigators have attempted to relate the imagery results based on paired-associate and other laboratory-learning tasks to the comprehension of prose materials (cf. Levin, 1972a). The basic premise behind this research is that visual imagery constitutes an effective organizational strategy which will serve to improve one's comprehension and recall of connected discourse.

Indirect evidence for this proposition comes from the work of Paivio (summarized in his 1971 book), who has demonstrated repeatedly that materials which are image-evoking (as determined from subject ratings) are better learned than materials which are not image-evoking, even when such characteristics as word frequency, meaningfulness, and the like have been controlled. Moreover, the same general result has been noted with image-evoking sentences (e.g., Cunningham, 1972) and image-evoking prose passages (e.g., Yuille & Paivio, 1969).

In contrast to the research in which image-evoking properties of learning materials have been manipulated, more direct evidence for the proposition has come from experiments wherein subjects are given formal instructions to generate visual images that integrate what is being learned (Bower, 1972; Levin, 1972b). In such experiments, imagery instructions have been found to facilitate performance. Similarly, when subjects are given the instruction, prior to reading a passage, to "try to get a picture in your mind of what is happening in the story, what the characters are doing, what things look like, etc.," their subsequent recall of facts in the passage is also increased. What is puzzling, however, is that the effect of imagery instructions in reading tasks typically is not nearly as dramatic or consistent as it is in so-called "rote-learning" tasks (Anderson & Kulhavy, 1972; Gibbons & Boutwell, 1972; Levin, 1973; Montague & Carter, 1973).

Although it is reasonable to assume that the addition of an organizational strategy (e.g., visual imagery instructions) is less likely to be facilitative for materials which already possess an inherent structure (i.e., prose passages) than for those which do not (i.e., rote-learning materials), the present reseach was founded on a more tantalizing assumption. The assumption, stated simply, is that even though visual imagery may be an effective <u>comprehension</u> strategy, it may not be a terribly effective <u>reading comprehension</u> strategy.

Empirical evidence in support of this assumption has been marshalled from research seeking to verify the psychological reality of cognitive processes (e.g., Atwood, 1971; Brooks, 1968). In essence, it has been argued that separate internal "systems" exist for the processing of visual-imaginal information on the one hand, and verbal-auditory information on the other. Thus the question may be asked, "Is visual imagery really <u>visual</u>?" in the sense that it shares a system represented by visual perception. The experiments reported here provide prose-learning data bearing on this question.

II
Experiment I

Method

Design and Materials

Two concrete ten-sentence passages were constructed. Following Matz and Rohwer (1971), the attributes of two subclasses were contrasted in each passage (two kinds of monkeys in one passage, and two kinds of cars in the other). The attributes associated with one of the subclasses were presented in the first five sentences, and those of the other subclass were presented in the second five sentences. Each sentence was typed on a 5" x 7" index card and inserted into a looseleaf binder.

For each passage, questions based on each of the subclass attributes were typed on cards, one to a card. With the exception of the first two questions which dealt with the major defining attributes of the two subclasses, the order of question-asking was randomized (by shuffling the cards) for each subject. The order of the first two questions was randomized within the first two question positions for each subject.

The experimental design consisted of the mode in which subjects were presented the passage--half of the subjects read it and half of the subjects listened to it--and the kind of instructions given to subjects prior to receiving the passage: regular or imagery. These two factors yielded the 2x2 design of major interest.

Subjects

Forty-eight fourth graders from a semirural community in the Midwest served as subjects. Subjects were blocked on reading ability (good vs. average) as determined by composites formed from the reading comprehension subtest of the Stanford Achievement Test, from homeroom teachers' evaluations of reading performance, and from reading group placements within the school. The few children with emotional-behavioral problems were excluded from the sample. After the two blocks were formed, subjects were randomly assigned in equal numbers to the four experimental conditions previously described.

Procedure

Upon entering the experimental room, subjects were informed that they would be reading (or listening to) a story, followed by some questions about it. Subjects in the imagery conditions were given instructions to get pictures in their minds of what was happening in the story as they read it. In both regular and imagery conditions, subjects received a practice sentence followed by a practice question.

Each subject was then presented one of the the two passages. In the reading conditions, subjects were allowed to take as long as they needed to read each sentence silently, but were not allowed to look back once they had flipped over a card. In the listening conditions, subjects were played a tape-recorded version of the passage. As soon as subjects in either condition were finished, they responded orally to the ten questions read by the experimenter, each of which could be answered in a word or short phrase.

Results

For each subject, substance recall was determined by using a "blind" scoring procedure. The average number of correctly answered questions (out of 10), by presentation mode and type of instructions, may be found in Figure 1. An analysis variance of these data (for which the sum of squares due to the passage main effect was removed) revealed that both the instructions main effect ($F = 8.45$, $df = 1/39$, $p < .01$) and the instructions by presentation mode interaction ($F = 4.69$, $df = 1/39$, $p < .05$)

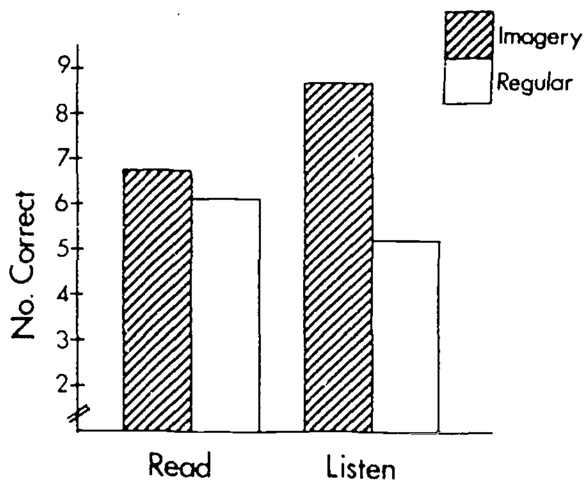

Fig. 1. Performance data of Experiment I.

were statistically significant. The interaction may be explained by the effect of imagery instructions being greater in the listening than in the reading conditions. No significant effects associated with reading ability (high vs. average) were detected, which probably resulted from the generally high mean reading ability of students in this school district (over half a year above grade level).

Discussion

A tentative explanation of these results, based on the process interpretation mentioned earlier, may be given as follows: Assume that visual imagery does in fact share a visual-processing system. Thus, when one reads after having been told to generate imagery, competing or antagonistic responses may be produced from visually processing the printed words while simultaneously (at least, let us suppose this for now) visually imagining the passage's description. If both activities "tie up" the same system, then executing them concurrently may be more difficult to achieve than is listening to the passage (tying up the verbal-auditory system) while generating visual imagery (tying up the visual system). If it is further assumed that information from one system can be easily related to information from the other, simultaneous processing in two different systems should be easier to achieve (i.e., more mutually compatible) than simultaneous processing in the same system.

One of the assumptions states that the reading/imagery conflict arises from two competing responses occurring simultaneously. In Experiment I, subjects were permitted to read the passage at their own pace (typically this took between five and ten seconds per sentence). Thus, it might be argued that at least for some subjects the "conflict" was minimized in that there may have been ample time to execute the two visual responses sequentially (i.e., first read the sentence and then imagine the content). Experiment II was therefore conducted to consider this possibility.

III
Experiment II

Method

Design and Materials

Slightly modified Experiment I passages were typed on cards, photographed, and mounted on slide transparencies, one sentence per slide. With the use of a slide projector and a mechanical timer, it was possible to display each sentence in a passage for either 7 seconds (slow rate) or $3\frac{1}{2}$ seconds (fast rate). From pilot-testing it had been determined that the fast rate was just fast enough for subjects to read a sentence through once quickly with comprehension. Based on the results of Experiment I, it was predicted that imagery for listening would be relatively better than imagery for reading. Moreover, by speeding up the task, it was anticipated that there would be relatively greater difficulty in generating images for subjects in the reading conditions (due to competing visual responses), as compared with subjects in the listening conditions (due to the presumed compatibility of visual and auditory responses).

The design consisted of the four basic conditions of Experiment I crossed with the two presentation rates, thereby yielding a total of eight experimental conditions.

Subjects

One hundred and twelve fifth graders were recruited from a semirural Midwestern community. As in Experiment I, children with emotional and/or behavioral problems were excluded.

Procedure

Essentially the same procedure was followed as in Experiment I. In the reading conditions, subjects were presented one sentence at a time via a Kodak Carousel slide projector. Subjects given the slow rate were allowed to see each sentence for 7 seconds, and those given the fast rate were allowed to see each sentence for $3\frac{1}{2}$ seconds. In the listening conditions, the tape-recorded sentences were read in a manner that completely filled either a 7- or a $3\frac{1}{2}$-second interval. No sentences were too long to be read comfortably within a $3\frac{1}{2}$-second period. As in Experiment I, subjects received one of the two passages followed by oral test questions. After the questions, additional information was secured from the subjects, including a four-point rating which indicated the extent to which they generated visual imagery during passage presentation.

Results

To evaluate the questions of interest, the instructions and modes factors were nested within rates. Drawing from the results of Experiment I, all hypotheses were assessed as one-tailed tests ($\alpha = .05$), with the variation due to the passage main effect removed.

Mean performance scores are presented in the upper portion of Figure 2. Recall was statistically better at the slower rate than at the faster rate ($t = 3.02$, $df = 103$, $p < .01$), and listening was superior to reading within the fast rate ($t = 3.02$, $df = 103$, $p < .01$) but not within the slow rate ($t < 1$). While the instructional effects were in the right direction at both rates, neither was significant using $\alpha = .05$ (Slow: $t = 1.19$, $df = 103$, $p < .20$; Fast: $t = 1.63$, $df = 103$, $p < .06$). As in Experiment I, a significant instructions by presentation mode was detected at the slower rate ($t = 1.69$, $df = 103$, $p < .05$). However, the expectation that this interaction would be small in comparison to that at the faster rate (where $t < 1$) was not confirmed by the recall data.

Analysis of the reported imagery data (in the lower portion of Figure 2) yielded valuable supplementary information about the cognitive processes assumed to be operating. It was found that more imagery was reported at the slow than at the fast rate ($t = 1.96$, $df = 103$, $p < .05$). Moreover, at the slow rate imagery-instructed subjects reported more imagery than regular-instructed subjects ($t = 1.76$, $df = 103$, $p < .05$), while the amount of imagery reported in the reading and listening modes did not differ ($t < 1$). On the other hand, at the fast rate much more imagery was reported in the listening than in the reading conditions regardless of the instructions given ($t = 2.25$, $df = 103$, $p < .01$), while the effect of instructions was not significant ($t = 1.41$, $df = 103$, $p > .05$). At neither rate was the instructions by presentation mode interaction detected (both t's < 1).

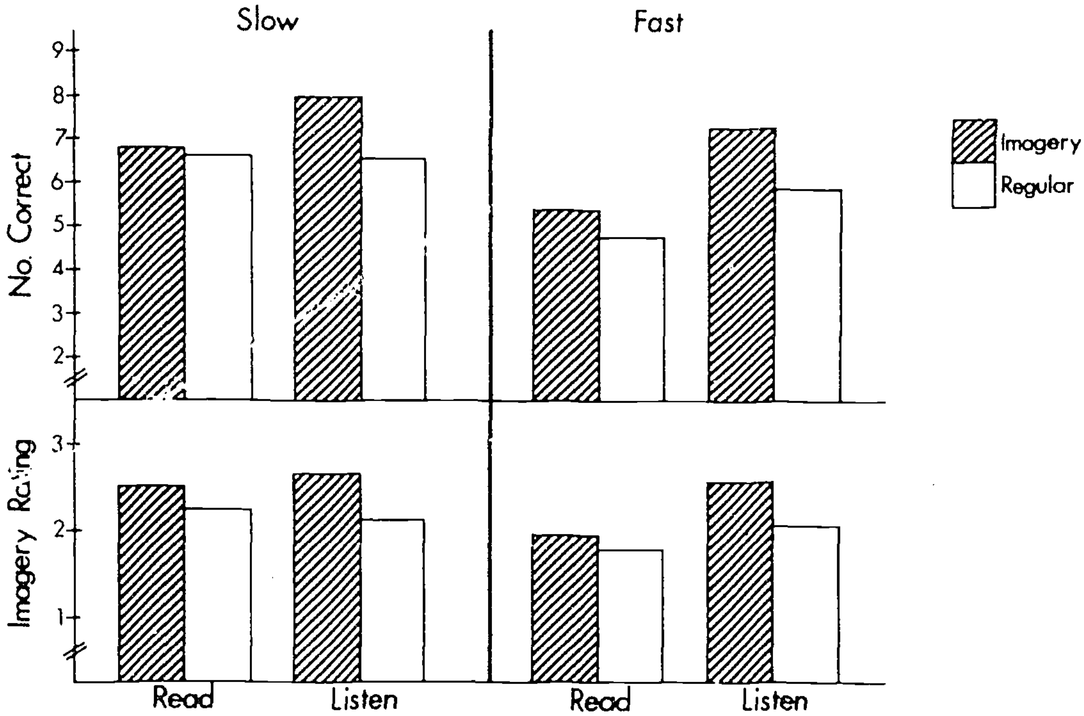

Fig. 2. Performance and imagery rating data of Experiment II.

IV
Discussion and Conclusions

Even though the instructions by presentation mode interaction of Experiment I was replicated at the slow rate in Experiment II, the fact that it was smaller at a faster rate does not permit unqualified support of the "compatibility" hypothesis, *viz*., that complementary visual imagery is more compatible with listening than with reading. However, if what is meant by "compatible" is merely processing ease or frequency, then the previously presented imagery rating data are consistent with the hypothesis.

To examine these data further, we identified a total of 50 out of 112 subjects (45%) who indicated that they had generated imagery for "almost all of the story"--the highest imagery rating category. At the slow rate, 34 out of 56 subjects (61%) reported this category, with 16 out of 28 (57%) being in the reading condition and 18 out of 28 (64%) being in the listening condition. (These latter two percentages are not statistically different, $\chi^2 < 1$.) At the fast rate, 16 out of 56 subjects (28%) used the highest imagery rating category. However, only 3 of 28 (11%) reading subjects used it, as compared with 13 of 28 (46%) listening subjects [χ^2 (Yates) = 7.09, $p < .01$]. Thus, at the fast rate, the differing compatibilities of imagery/reading and imagery/listening are reflected to a greater extent by subjective report data than by the objective recall data.

It is of additional interest that of the 50 "most frequent" imagery reporters, 20 of these came from nonimagery-instructed conditions. This merely serves to substantiate the claim that so-called "control" subjects do not always behave in nonstrategic ways (Bower, 1972; Rohwer, 1972). Indeed, visual imagery has previously been reported as a spontaneously occurring prose-learning strategy (Anderson & Kulhavy, 1972), just as it was here. Obviously the adoption of such a strategy on the part of noninstructed subjects only serves to minimize effects due to instructions.

By the same token, just as it cannot be assumed that subjects will in fact do what they are not instructed to do, neither can it be assumed that subjects will in fact do what they are instructed to do. Individuals are undoubtedly able to "switch on" (or "switch off") processing strategies which are appropriately (or inappropriately) matched with the character and complexity of the task which faces them. For example, Paivio's (1971) research suggests that a switching on or off of visual imagery may occur as a function of the concreteness of the materials to be learned: With concrete materials, imagery strategies are reported much more frequently (and their associated latencies are much shorter) than is the case with abstract materials where verbal strategies predominate. Similarly, in the present experiment it might be argued that when the task became too difficult (i.e., in the reading condition at the fast rate), subjects simply abandoned visual imagery in favor of other processing strategies. The subject-report data in Figure 2 certainly lend support to this conclusion.

In summary, the present research extends Brooks's (1967) results based on the comprehension of adults to the prose-learning of children. In both situations it was found that visual imagery may be elicited more readily (and with fewer adverse effects) in listening tasks than in reading tasks. The implications for studying the development of visual imagery strategies in visual-free contexts (i.e., listening as opposed to reading) should be obvious. At the same time, recent efforts to improve the comprehension skills of poor readers via experimenter-provided (Matz & Rohwer, 1971) or subject-generated (Levin, 1973) visual imagery strategies should not simply be thrown out the window.

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